Data Evaluation Record on the Acute Toxicity of GF-2726 (2,4-D Choline Salt + Glyphosate DMA) to Terrestrial Vascular Plants: Vegetative Vigor

PMRA Submission Number {.....} **EPA MRID Number 49903204**

Data Requirement:

PMRA Data Code:	9.8.4 (TGAI) or 9.8.6 (EP)
EPA DP Barcode:	
OECD Data Point:	IIA 8.12 (TGAI) and IIIA 10.8.1.1 (EP)
EPA Guideline:	850.4150

Test material: **2,4-D Choline Salt** **Purity:** 24.1%
Glyphosate Dimethylammonium **Purity:** 21.7%
Common name:
Chemical name: IUPAC:
CAS name:
CAS No.:
Synonyms: GF-2726, TSN306327

Primary Reviewer: Teresa Nelis **Signature:** Teresa Nelis
Senior Scientist, CDM Smith **Date:** 6/16/16

Secondary Reviewer: Teri S. Myers **Signature:** Teri S Myers
Senior Scientist, CDM Smith **Date:** 6/22/16

Primary Reviewer: Edward Odenkirchen, Ph.D./EPA **Date:** 08/02/2016
EPA/OPP/EFED

Secondary Reviewer(s): Kristina Garber/EPA **Date:** 8/11/2016
EPA/OPP/EFED

Reference/Submission No.: {.....}

Company Code {.....} [For PMRA]
Active Code {.....} [For PMRA]
Use Site Category: {.....} [For PMRA]
EPA PC Code: **051505 (2,4-D Choline Salt)**
103608 (Glyphosate DMA)

Date Evaluation Completed: 08/11/2016

CITATION: Lee, B. 2016. GF-2726 (2,4-D Choline Salt, 286 g a.s/L; Glyphosate Dimethylammonium 260 g a.s./L; SL): Effects on the Vegetative Vigor of Non-Target Terrestrial Plants – Non Crop Species (Tier II). Unpublished study performed by ABC Laboratories, Columbia, Missouri, and sponsored by Dow AgroSciences LLC, Indianapolis, Indiana. ABC Study No. 83628; Dow AgroSciences Study No. 160375. Study completed April 29, 2016.

DISCLAIMER: This document provides guidance for EPA and PMRA reviewers on how to complete a data evaluation record after reviewing a scientific study concerning the acute toxicity of a pesticide to terrestrial vascular plants. It is not intended to prescribe conditions to any external party for conducting this study nor to establish absolute criteria regarding the assessment of whether the study is scientifically sound and whether the study satisfies any applicable data requirements. Reviewers are expected to review and to determine for each study, on a case-by-case basis, whether it is scientifically sound and provides sufficient information to satisfy applicable data requirements. Studies that fail to meet any of the conditions may be accepted, if appropriate; similarly, studies that meet all of the conditions may be rejected, if appropriate. In sum, the reviewer is to take into account the totality of factors related to the test methodology and results in determining the acceptability of the study.

Data Evaluation Record on the Acute Toxicity of GF-2726 (2,4-D Choline Salt + Glyphosate DMA) to Terrestrial Vascular Plants: Vegetative Vigor

PMRA Submission Number {.....} **EPA MRID Number 49903204**

Data Requirement:
PMRA Data Code: 9.8.4 (TGAI) or 9.8.6 (EP)
EPA DP Barcode:
OECD Data Point: IIA 8.12 (TGAI) and IIIA 10.8.1.1 (EP)
EPA Guideline: 850.4150

Test material: **2,4-D Choline Salt** **Purity:** 24.1%
Glyphosate Dimethylammonium **Purity:** 21.7%
Common name:
Chemical name: IUPAC:
CAS name:
CAS No.:
Synonyms: GF-2726, TSN306327

Primary Reviewer: Teresa Nelis **Signature:** Teresa Nelis
Senior Scientist, CDM Smith **Date:** 6/16/16

Secondary Reviewer: Teri S. Myers **Signature:** Teri S Myers
Senior Scientist, CDM Smith **Date:** 6/22/16

Primary Reviewer: Edward Odenkirchen, Ph.D./EPA **Date:** 08/02/2016
EPA/OPP/EFED

Secondary Reviewer(s): Kristina Garber/EPA **Date:** 8/11/2016
EPA/OPP/EFED

Reference/Submission No.: {.....}

Company Code {.....} [For PMRA]
Active Code {.....} [For PMRA]
Use Site Category: {.....} [For PMRA]
EPA PC Code: **051505 (2,4-D Choline Salt)**
103608 (Glyphosate DMA)

Date Evaluation Completed: 08/11/2016

CITATION: Lee, B. 2016. GF-2726 (2,4-D Choline Salt, 286 g a.s/L; Glyphosate Dimethylammonium 260 g a.s./L; SL): Effects on the Vegetative Vigor of Non-Target Terrestrial Plants – Non Crop Species (Tier II). Unpublished study performed by ABC Laboratories, Columbia, Missouri, and sponsored by Dow AgroSciences LLC, Indianapolis, Indiana. ABC Study No. 83628; Dow AgroSciences Study No. 160375. Study completed April 29, 2016.

DISCLAIMER: This document provides guidance for EPA and PMRA reviewers on how to complete a data evaluation record after reviewing a scientific study concerning the acute toxicity of a pesticide to terrestrial vascular plants. It is not intended to prescribe conditions to any external party for conducting this study nor to establish absolute criteria regarding the assessment of whether the study is scientifically sound and whether the study satisfies any applicable data requirements. Reviewers are expected to review and to determine for each study, on a case-by-case basis, whether it is scientifically sound and provides sufficient information to satisfy applicable data requirements. Studies that fail to meet any of the conditions may be accepted, if appropriate; similarly, studies that meet all of the conditions may be rejected, if appropriate. In sum, the reviewer is to take into account the totality of factors related to the test methodology and results in determining the acceptability of the study.

EXECUTIVE SUMMARY:

The effect of **GF-2726 (2,4-D Choline Salt + Glyphosate Dimethylammonium)** on the vegetative vigor of one monocot (Quackgrass, *Agropyron repens*) and two dicot species (Horseweed, *Conyza canadensis*; and Lambsquarter, *Chenopodium album*) was studied. All three of these species are targets of the formulation tested (i.e. they are considered weed species). Nominal concentrations tested on lambsquarter were 0 (negative control), 0.00138, 0.0027, 0.0055, 0.0110, 0.0221, 0.044, 0.088, 0.176, 0.35, and 0.71 lb 2,4-D Choline Salt/A, and 0 (negative control), 0.00124, 0.0025, 0.0050, 0.0099, 0.0199, 0.040, 0.079, 0.159, 0.32, and 0.64 lb Glyphosate DMA/A. Quackgrass was tested with all concentrations except the highest and lowest, and horseweed was tested on all concentrations except the highest. Measured concentrations, used in analyses for the four highest treatment levels, were 0.083, 0.179, 0.35, and 0.70 lb 2,4-D Choline Salt/A. Glyphosate DMA concentrations were not confirmed analytically.

The growth medium used in the vegetative vigor test was a top soil silica sand mix (sandy loam, pH 6.4, organic carbon 1.5%). On day 21 the surviving plants per pot were recorded and cut at soil level for measuring the plant height and dry weight.

Seedling survival in the negative control was 100%. Significant inhibitions for survival compared to the negative control were observed in quackgrass and not in the other species tested. Significant inhibitions in quackgrass survival were 24% at the highest treatment level, 0.35 lb 2,4-D Choline Salt/A (Mann-Whitney U Two-Sample test, $p<0.05$).

Significant inhibitions in seedling height compared to the negative control were found in all species tested. Significant inhibitions in horseweed height were 9, 24, 44, 59, and 7% at the 0.0221, 0.044, 0.083, 0.179, and 0.35 lb 2,4-D Choline Salt/A treatment levels, respectively (Williams test, $p<0.05$). Lambsquarter significant decreases in height were 65, 65, 68, and 77% at the 0.083, 0.179, 0.35 and 0.70 lb 2,4-D Choline Salt/A treatment levels, respectively, (Williams test, $p<0.05$). Significant inhibitions in quackgrass height were 27 and 26% at the 0.179 and 0.35 lb ai/A treatment levels, respectively, compared to the negative control (Dunnett's test, $p<0.05$).

There were also significant inhibitions in dry weight compared to the negative control in all species tested. Significant inhibitions in horseweed dry weight were 19, 29, 71, 88, and 3% at the 0.0221, 0.044, 0.083, 0.179, and 0.35 lb ai/A treatment level, respectively, compared to the negative control (Williams test, $p<0.05$). Significant decreases in lambsquarter dry weight were 47, 43, 60, and 71% at the 0.083, 0.179, 0.35 and 0.70 lb ai/A treatment levels, respectively (Williams test, $p<0.05$). For quackgrass dry weight, significant inhibitions were 52 and 70% at the 0.179 and 0.35 lb ai/A treatment level, respectively, compared to the negative control (Dunnett's test, $p<0.05$).

The most sensitive monocot was quackgrass based on dry weight with NOAEC and IC_{25} values of 0.083 and 0.113 lb 2,4-D Choline Salt/A, respectively. The most sensitive dicot was horseweed based on dry weight. The top dose growth data for this species exhibited a response contrary to the observed dose-dependent pattern; as a result, the study author excluded the top dose from growth analyses, while the reviewer conducted and reports analyses including and excluding this level. The NOAEC was 0.0110, regardless of top dose inclusion. The IC_{25} value with data included was 0.0112 lb 2,4-D Choline Salt/A and 0.0275 lb 2,4-D Choline Salt/A with data excluded, respectively.

In terms of Glyphosate DMA, the most sensitive monocot quackgrass based on dry weight with NOAEC and IC_{25} values of 0.075 and 0.102 lb Glyphosate DMA/A, respectively. The most sensitive dicot was horseweed based on dry weight with NOAEC and IC_{25} values of 0.0099 and 0.0101 lb Glyphosate DMA/A (top dose included) and 0.0248 lb Glyphosate DMA/A (top dose excluded), respectively. In terms of Total Product GF-2726, the most sensitive monocot was quackgrass based on dry weight with NOAEC and IC_{25} values of 0.344 and 0.469 lb Total Product/A, respectively. The most sensitive dicot was horseweed based on dry weight with NOAEC and IC_{25} values of 0.0456 and 0.0465 lb Total Product/A (top dose included) and 0.1141 lb Total Product/A (top dose excluded),

respectively.

There were moderate phytotoxic effects in quackgrass (up to 60), and severe effects in horseweed and lambsquarter (up to 70). Phytotoxic effect observed included chlorosis, epinasty, necrosis, stunting and wilting. Phytotoxic effects were dose-related in all species tested.

Maximum Labeled Rate: Not reported

Results Synopsis

2,4-D Choline Salt

Monocot

Most sensitive monocot: Quackgrass based on dry weight

EC_{50}/IC_{50}: 0.191 lb ai/A	95% C.I.: 0.155-0.235 lb ai/A
EC_{25}/IC_{25}: 0.113 lb ai/A	95% C.I.: 0.0725-0.155 lb ai/A
EC_{05}/IC_{05}: 0.0535 lb ai/A	95% C.I.: N/A-0.0836 lb ai/A
NOEC: 0.083 lb ai/A	
Slope: N/A	95% C.I.: N/A

Dicot

Most sensitive dicot: Horseweed based on dry weight (with top dose included)

EC_{50}/IC_{50}: 0.149 lb ai/A	95% C.I.: 0.0572-0.39 lb ai/A
EC_{25}/IC_{25}: 0.0112 lb ai/A	95% C.I.: 0.00261-0.0352 lb ai/A
EC_{05}/IC_{05}: 0.000266 lb ai/A	95% C.I.: N/A-0.00624 lb ai/A
NOEC: 0.0110 lb ai/A	
Slope: N/A	95% C.I.: N/A

Most sensitive dicot: Horseweed based on dry weight (with top dose excluded)

EC_{50}/IC_{50}: 0.0532 lb ai/A	95% C.I.: 0.0464-0.0609 lb ai/A
EC_{25}/IC_{25}: 0.0275 lb ai/A	95% C.I.: 0.0218-0.0335 lb ai/A
EC_{05}/IC_{05}: 0.0106 lb ai/A	95% C.I.: 0.00199-0.0151 lb ai/A
NOEC: 0.0110 lb ai/A	
Slope: N/A	95% C.I.: N/A

Glyphosate DMA

Monocot

Most sensitive monocot: Quackgrass based on dry weight

EC_{50}/IC_{50}: 0.172 lb ai/A	95% C.I.: 0.140-0.212 lb ai/A
EC_{25}/IC_{25}: 0.102 lb ai/A	95% C.I.: 0.065-0.140 lb ai/A
EC_{05}/IC_{05}: 0.048 lb ai/A	95% C.I.: N/A-0.075 lb ai/A
NOEC: 0.075 lb ai/A	
Slope: N/A	95% C.I.: N/A

Dicot

Most sensitive dicot: Horseweed based on dry weight (with top dose included)

EC_{50}/IC_{50}: 0.134 lb ai/A	95% C.I.: 0.052-0.351 lb ai/A
EC_{25}/IC_{25}: 0.010 lb ai/A	95% C.I.: 0.0024-0.0317 lb ai/A
EC_{05}/IC_{05}: 0.00024 lb ai/A	95% C.I.: N/A-0.0056 lb ai/A
NOEC: 0.0099 lb ai/A	
Slope: N/A	95% C.I.: N/A

Most sensitive dicot: Horseweed based on dry weight (with top dose excluded)

EC_{50}/IC_{50}: 0.048 lb ai/A	95% C.I.: 0.042-0.055 lb ai/A
EC_{25}/IC_{25}: 0.0248 lb ai/A	95% C.I.: 0.0196-0.0302 lb ai/A
EC_{05}/IC_{05}: 0.00954 lb ai/A	95% C.I.: 0.0018-0.0136 lb ai/A
NOEC: 0.0099 lb ai/A	
Slope: N/A	95% C.I.: N/A

Table 1 (Tier II studies). Summary of most sensitive parameters by species (lb 2,4-D Choline Salt/A).

Species	Endpoint	NOEC	EC_{05}/IC_{05}	EC_{25}/IC_{25}	EC_{50}/IC_{50}
Horseweed	Dry weight	0.0110	0.000266	0.0112	0.149
Horseweed*	Dry weight	0.0110	0.0106	0.0275	0.0532
Lambsquarter	Height	0.044	0.00632	0.0352	0.116
Quackgrass	Dry weight	0.083	0.0535	0.113	0.191

Table 1a (Tier II studies). Summary of most sensitive parameters by species (lb Glyphosate DMA/A).

Species	Endpoint	NOEC	EC_{05}/IC_{05}	EC_{25}/IC_{25}	EC_{50}/IC_{50}
Horseweed	Dry weight	0.0099	0.0002	0.010	0.134
Horseweed*	Dry weight	0.0099	0.00954	0.0248	0.048
Lambsquarter	Height	0.0396	0.0057	0.032	0.104
Quackgrass	Dry weight	0.075	0.048	0.102	0.17

*Excluding data for top dose

This study is scientifically sound and is classified as acceptable.

I. MATERIALS AND METHODS

GUIDELINE FOLLOWED: This study was conducted in compliance with OCSPP Guideline 850.4150: Vegetative Vigor (January 2012). The reviewer evaluated the study methods according to EPA Ecological Effects Test Guidelines, OCSPP Guideline 850.4150: Vegetative Vigor. There were some deficiency and deviations noted by the reviewer.

1. The quackgrass study included 25 seedlings per treatment, and EPA recommends a minimum of 30 seedlings per treatment. The study author indicated they communicated with EPA, and EPA approved 25 seedlings per treatment.

2. The study author reported that for horseweed, there was a clear monotonic treatment-dependent effect on mean shoot weight between 0.0221 and 0.176 lb 2,4 D Choline Salt/A, but this was not evident at the highest treatment level (0.35 lb 2,4 D Choline Salt/A). The reason for the inconsistent response at the highest treatment rate is uncertain, but is unlikely to be due to incorrect treatment preparation given that the other species did not show a similar response. However, due to this inconsistency, the study author excluded the highest treatment level from the statistical analysis to provide a conservative assessment of the effect on shoot weight for horseweed. The reviewer conducted statistical analyses both including and excluding the top dose.

3. The physico-chemical properties of the test material were not reported.

The deficiency and deviations did not have an impact on the acceptability of this study.

COMPLIANCE: Signed and dated GLP, Quality Assurance and Data Confidentiality statements were provided. This study was conducted in compliance with USEPA Good Laboratory Practice Standards (40 CFR, Part 160, 1989), with the following exceptions: the latest water characterizations performed in June 2015, and the photographic data of test plants, were not collected in accordance with the stated GLP.

A. MATERIALS:

1. Test Material **GF-2726 (2,4-D Choline Salt + Glyphosate Dimethylammonium)**

Description: Solid

Lot No./Batch No.: 2C01163R01

Purity: 2,4-D Choline Salt: 24.1%
Glyphosate DMA: 21.7%

Stability of compound under test conditions: Analytical determinations based on measured concentration of the four highest test concentrations in the initial spray solution yielded recoveries of 93-102% of nominal (n = 8). Analytical determinations based on measured concentration of the four highest test concentrations in the post application spray solution yielded recoveries of 96-105% of nominal (n = 8). The comparability between pre- and post-application spray solutions indicates the test substance was stable over the treatment period.

(OECD recommends chemical stability in water and light)

Storage conditions of test chemicals: The test material was stored at room temperature.

Table 2. Physical/chemical properties of GF-2726.

Parameter	Values	Comments
Water solubility at 20˚C	Not reported	
Vapor pressure	Not reported	
UV absorption	Not reported	
pKa	Not reported	
Kow	Not reported	

2. Test organism:

Monocotyledonous species: Quackgrass (*Agropyron repens*, Poaceae; EPPO). *EPA recommends four monocots in two families, including corn.*
Dicotyledonous species: Horseweed (Marestail) (*Conyza canadensis*, Asteraceae; EPPO); and Lambsquarter (*Chenopodium album*, Chenopodiaceae; EPPO) *EPA recommends six dicots in four families, including soybean and a root crop.*

OECD recommends a minimum of three species selected for testing, at least one from each of the following categories: Category 1: ryegrass, rice, oat, wheat, and sorghum; Category 2: mustard, rape, radish, turnip, and Chinese cabbage; Category 3: vetch, mung bean, red clover, fenugreek, lettuce, and cress.

Seed source: Quackgrass, horseweed, and lambsquarter seed obtained from Dow AgroSciences.
Prior seed treatment/sterilization: The seeds were not treated with any type of fungicides, insecticides, or any pesticides.
Historical % germination of seed: Quackgrass (5%), horseweed (20-40%), and lambsquarters (75%).
Seed storage, if any: Not reported.

B. STUDY DESIGN:

1. Experimental Conditions

a. Limit test: None.

b. Range-finding study: None.

c. Definitive Study

Table 3: Experimental Parameters - Vegetative Vigor.

Parameters	**Vegetative vigor**	
	Details	**Remarks**
		Criteria
Duration of the test	21 days	
		Recommended test duration is 14-21 days. *OECD recommends that the test be terminated no sooner than 14 days after 50 percent of the control seedlings have emerged*
Number of seeds/plants/species/ replicate	Quackgrass 5 plants/pot, 1 pot/replicate, 5 replicates Horseweed 2 plants/pot, 3 pots/replicate, 6 replicates Lambsquarter 5 plants/pot, 1 pot/replicate, 6 replicates	
		Five plants per replicate are recommended.
Number of plants retained after thinning	Grown to seedlings and thinned to 2 to 5 plants per pot, having similarity in size and condition.	
Number of replicates	Quackgrass	

Parameters	Vegetative vigor	
	Details	**Remarks**
		Criteria
Control: Adjuvant control: Treated: Control: Adjuvant control: Treated:	5 N/A 5 <u>Horseweed and Lambsquarter</u> 6 N/A 6	*Four replicates per dose should be used.* *OECD recommends a minimum of four replicates per treatment*
<u>Test concentrations (lb ai/A)</u> Nominal: Measured:	<u>Lambsquarter</u> 0 (negative control), 0.00138, 0.0027, 0.0055, 0.0110, 0.0221, 0.044, 0.088, 0.176, 0.35, and 0.71 lb 2,4-D Choline Salt/A <u>Quackgrass</u> 0 (negative control), 0.0027, 0.0055, 0.0110, 0.0221, 0.044, 0.088, 0.176, and 0.35 lb 2,4-D Choline Salt/A <u>Horseweed</u> 0 (negative control), 0.00138, 0.0027, 0.0055, 0.0110, 0.0221, 0.044, 0.088, 0.176, and 0.35 lb 2,4-D Choline Salt/A <u>Four highest test concentrations:</u> 0.083, 0.179, 0.35, and 0.70 lb 2,4-D Choline Salt/A.	Nominal concentrations for Glyphosate DMA: 0 (negative control), 0.00124, 0.0025, 0.0050, 0.0099, 0.0199, 0.040, 0.079, 0.159, 0.32, and 0.64 lb Glyphosate DMA/A Nominal concentrations for GF-2726 product: 0.00572, 0.0114, 0.0229, 0.0457, 0.0915, 0.183, 0.366, 0.732, 1.46, and 2.93 lb product/A. *Five test concentrations should be used with a dose range of 2X or 3X progression* *OECD recommends three concentrations, preferably with application rates equivalent to 0.0 (control), 1.0, 10.0 and 100 mg substance per kg of oven-dried soil.*
<u>Method and interval of analytical verification</u> LOQ: LOD:	Spray solutions were analyzed by HPLC using a Waters Symmetry C18 column. 0.0077 lb 2,4-D Choline Salt/A (MQL) Not reported.	2,4-D acid, the acid equivalent active ingredient of GF-2726, was measured in the spray solutions, and converted to 2,4-D Choline Salt concentrations.
Adjuvant (type, percentage, if used)	N/A	
<u>Test container (pot)</u>		

Parameters	Vegetative vigor	
	Details	**Remarks**
		Criteria
Size/Volume Material: (glass/polystyrene)	Quackgrass and Lambsquarter Pots with top diameter of 16.5 cm x 11.5 cm depth. Plastic Horseweed Pots with top diameter of 10 cm x 15 cm depth. Plastic	*Non-porous containers should be used.* *OECD recommends that non-porous plastic or glazed pot be used.*
Growth facility	Greenhouse	
Method/depth of seeding	Seeds were planted and allowed to emerge and the appropriate number of seedlings selected prior to application.	
Test material application Application time including the plant growth stage Number of applications Application interval Method of application	Quackgrass: 3-7 leaf stage Horseweed: 4-14 leaf stage Lambsquarter: 6-12 leaf stage 1 N/A- single application Application of the test substance was made using an overhead track sprayer (De Vries) equipped with a TeeJet 4002E nozzle operated at 40 psi, approximately 27 inches above the soil surface (140 L/ha nominal spray volume)	
Details of soil used Geographic location Depth of soil collection	 Lime Spring, Iowa N/A	Top soil mixed with silica sand. Organic Matter: 2.5%

Parameters	**Vegetative vigor**	
	Details	**Remarks**
		Criteria
Soil texture % sand % silt % clay pH: % organic carbon CEC Moisture at 1/3 atm (%)	Sandy loam 71 18 11 6.4 1.5% 11.0 meq/100g 13.9%	*Soil mixes containing sandy loam, loam, or clay loam soil with no greater than 2% organic matter are preferable. Glass beads, rock wool, and 100% acid washed sand are not preferred.* *OECD prefers the soil to be sieved (0.5 cm) to remove coarse fragments. Carbon content should not exceed 1.5% (3% organic matter). Fine particles (under 20um) makeup should be between 10 and 20%. The recommended pH is between 5.0 and 7.5.*
Details of nutrient medium, if used	N/A	
<u>Watering regime and schedules</u> Water source/type: Volume applied: Interval of application: Method of application:	Top watered once post-application, then sub-irrigation. Well water. Not reported. Daily. The plants were bottom watered daily as needed.	*EPA prefers that bottom watering be utilized for vegetative vigor studies so that the chemical is not leached out of the soil during the test.*
Any pest control method/fertilization, if used	Peter's 20-20-20 (1/2 tablespoon/gallon). Applied once via sub-irrigation to all species.	
<u>Test conditions</u> Temperature: Photoperiod: Light intensity and quality: Relative humidity:	 mean 19.5, range 11.9-31.0˚C 16L:8D Natural sunlight supplemented with artificial light. mean 224, mean range 121-348 PAR (µmol/m^2/sec) mean 65, range 15-95%	*EPA prefers that the cold vs warm loving plants be tested in two separate groups to optimize plant growth.* *OECD prefers that the temperature, humidity and light conditions be suitable for maintaining normal growth of each species for the test period.*
<u>Reference chemical (if used)</u> Name: Concentrations:	 N/A	
Other parameters, if any	None	

2. Observations:

Table 4: Observation Parameters - Vegetative vigor.

Parameters	Vegetative vigor	
	Details	**Remarks**
Parameters measured (e.g., number of germinated seeds, emerged seedlings, plant height, dry weight or other endpoints)	- Survival - Shoot height - Total dry weight - Phytotoxicity	
Measurement technique for each parameter	Phytotoxicity was visually determined. Survival was defined as the percent of emerged. Height was measured from the base of the stem to the tip of the longest leaf or apical bud. Total replicate weight was determined following drying.	
Observation intervals	Each pot was inspected weekly, and phytotoxicity assessments performed. Plant height and dry weight were recorded at study termination.	
Other observations, if any	N/A	
Were raw data included?	Yes	
Phytotoxicity rating system, if used	No effect, 1-10, no effect; 20-30, slight effect; 40-60, moderate effect; 70-100, severe effect; 100, complete effect.	Frans, R.E. and R.E. Talbert, 1977.

II. RESULTS and DISCUSSION:

A. INHIBITORY EFFECTS:

1. Vegetative vigor:

Study author found seedling survival in the negative control was 100%. The study author reported significant inhibitions for survival compared to the negative control in quackgrass and not in the other species tested. Significant inhibitions in quackgrass survival was 24% at the 0.35 lb 2,4-D Choline Salt/A treatment level compared to the negative control (Cochran-Armitage test, $p<0.05$). The reviewer also found seedling survival in the negative control was 100%, and significant inhibitions in quackgrass survival of 24% at the highest treatment level (Mann-Whitney U Two-Sample test, $p<0.05$)

The study author found significant inhibitions in seedling height compared to the negative control in all species tested. Significant inhibitions in horseweed height were 9, 24, 44, 59, and 7% at the 0.0221, 0.044, 0.088, 0.176, and 0.35 lb 2,4-D Choline Salt/A treatment levels, respectively (Jonckheere-Terpstra test, $p<0.05$). The study author excluded the horseweed data for the 0.35 lb 2,4-D Choline Salt/A treatment in ECx analysis because the mean height was much higher than the height of the preceding treatment levels. Lambsquarter significant decreases in height were 65, 65, 68, and 77% at the 0.088, 0.176, 0.35 and 0.71 lb 2,4-D Choline Salt/A treatment levels, respectively, (Jonckheere-Terpstra test, $p<0.05$). Significant inhibitions in quackgrass height were 27 and 26% at the 0.176 and 0.35 lb ai/A treatment levels, respectively, compared to the negative control (Jonckheere-Terpstra test, $p<0.05$). The reviewer found similar inhibitions in height compared to the negative control for horseweed and lambsquarter (Williams test, $p<0.05$), and quackgrass (Dunnett's test, $p<0.05$). The reviewer included the 0.35 lb 2,4-D Choline Salt/A height data for horseweed in the ICx analysis.

The study author also found significant inhibitions in dry weight compared to the negative control in all species tested. Significant inhibitions in horseweed dry weight were 18, 29, 71, 88, and 3% at the 0.0221, 0.044, 0.088, 0.176, and 0.35 lb ai/A treatment levels, respectively, compared to the negative control (Jonckheere-Terpstra test, $p<0.05$). The study author excluded the horseweed data for the 0.35 lb 2,4-D Choline Salt/A in ECx analysis because the mean dry weight was much higher than the dry weight of the preceding treatment levels. Lambsquarter significant inhibitions in dry weight were 43, 60, and 71% at the 0.176, 0.35 and 0.71 lb ai/A treatment levels, respectively, and quackgrass dry weight significant inhibitions were 52 and 79% at the 0.176 and 0.35 lb ai/A treatment levels, respectively (Jonckheere-Terpstra test, $p<0.05$). The reviewer also found significant inhibitions in dry weight compared to the negative control in all species tested. The reviewer found similar significant inhibitions to the study author for horseweed dry weight (Williams test, $p<0.05$), and quackgrass dry weight (Dunnett's test, $p<0.05$). Significant decreases in lambsquarter dry weight were 47, 43, 60, and 71% at the 0.083, 0.179, 0.35 and 0.70 lb ai/A treatment levels, respectively (Williams test, $p<0.05$). The reviewer included the 0.35 lb 2,4-D Choline Salt/A dry weight data for horseweed in the ICx analysis.

Based on the study author's results, the most sensitive monocot was quackgrass based on dry weight, with NOEC and ER_{25} values of 0.088 and 0.116 lb 2,4-D Choline Salt/A, respectively; the most sensitive dicot was horseweed based on dry weight, with NOEC and ER_{25} values of 0.0110 and 0.0287 lb 2,4-D Choline Salt/A, respectively.

There were moderate phytotoxic effects in quackgrass (up to 60), and severe effects in horseweed and lambsquarter (up to 70). Phytotoxic effect observed included chlorosis, epinasty, necrosis, stunting and wilting. Phytotoxic effects were dose-related in all species tested.

B. REPORTED STATISTICS:

Survival, replicate shoot dry weight, and height mean and standard deviations were determined. Statistical analysis of rate versus effect data was performed using SAS Version 9.3. Survival data were tested using a combination of Fisher's Exact Comparison with Bonferroni-Holm Adjustment, and Cochran Armitage test. Length and weight data sets were tested for normality (Shapiro-Wilk) and homogeneity of variance (Levene's). Non-normal and/or non-homogeneous data sets were analyzed using non-parametric procedures (Wilcoxon scores analyzed using Dunn's multiple comparison), as well as trend testing (Jonckheere's). Normally distributed and homogenous data sets were analyzed using parametric procedures (Dunnett's pair-wise comparison), as well as trend testing (Jonckheere's). All statistical determinations were made with 95% certainty. Due to significant effects from NOER determinations, post-emergent survival data were analyzed using Probit methods, and plant shoot length and dry weight data was analyzed using non-linear regression

dose-response models (Bruce, Versteeg Weighted Probit, Schabenberger Hormetic, and OECD Model 2; all models were fitted to the data using the Marquardt method). Nominal concentrations were used for all analyses.

Table 5: Effect of GF-2726 on 21-Day Vegetative Vigor

Species	Results summary for height (lbs 2,4-D Choline Salt/A)									
	height (mm)	NOEC	IC_{05}	95%CI	IC_{25}	95%CI	IC_{50}	95%CI	slope	95%CI
Horseweed[1]	67-175	0.11	ND	N/A	0.041	0.032-0.052	0.11	0.10-0.13	N/A	N/A
Lambsquarter[2]	69.2-340	0.044	ND	N/A	0.055	0.021-0.14	0.12	ND	N/A	N/A
Quackgrass[3]	311-437	0.088	ND	N/A	0.28	0.20-0.40	0.35	ND	N/A	N/A

ND- Not determined. NC- Not calculable.

[1] Significant decrease in horseweed height, inhibition of 9, 24, 44, 59, and 7% at the 0.0221, 0.044, 0.088, 0.176, and 0.35 lb ai/A treatment levels, respectively, compared to the negative control (Jonckheere-Terpstra test, $p<0.05$). The study author excluded the data for 0.35 lb ai/A in ECx analysis.

[2] Significant decrease in lambsquarter height, inhibition of 65, 65, 68, and 77% at the 0.088, 0.176, 0.35 and 0.71 lb ai/A treatment levels, respectively, compared to the negative control (Jonckheere-Terpstra test, $p<0.05$).

[3] Significant decrease in quackgrass height, inhibition of 27 and 26% at the 0.176 and 0.35 lb ai/A treatment levels, respectively, compared to the negative control (Jonckheere-Terpstra test, $p<0.05$).

Table 5a: Effect of GF-2726 on 21-Day Vegetative Vigor

Species	Results summary for biomass (lbs 2,4-D Choline Salt/A)									
	weight (g)	NOEC	IC_{05}	95%CI	IC_{25}	95%CI	IC_{50}	95%CI	slope	95%CI
Horseweed[1]	0.0915-0.841	0.0110	ND	N/A	0.0287	0.022-0.037	0.055	0.046-0.064	N/A	N/A
Lambsquarter[2]	0.144-0.68	0.088	ND	N/A	0.106	0.061-0.18	0.22	0.12-0.42	N/A	N/A
Quackgrass[3]	0.15-0.645	0.088	ND	N/A	0.116	0.084-0.16	0.18	0.15-0.22	N/A	N/A

ND- Not determined. NC- Not calculable.

[1] Significant decrease in horseweed dry weight, inhibition of 18, 29, 71, 88, and 3% at the 0.0221, 0.044, 0.088, 0.176, and 0.35 lb ai/A treatment levels, respectively, compared to the negative control (Jonckheere-Terpstra test, $p<0.05$). The study author excluded data for the 0.35 lb ai/A treatment level in ECx analysis.

[2] Significant decrease in lambsquarter dry weight, inhibition of 43, 60, and 71% at the 0.176, 0.35 and 0.71 lb ai/A treatment levels, respectively, compared to the negative control (Jonckheere-Terpstra test, $p<0.05$).

[3] Significant decrease in quackgrass dry weight, inhibition of 52 and 79% at the 0.176 and 0.35 lb ai/A treatment levels, respectively, compared to the negative control (Jonckheere-Terpstra test, $p<0.05$).

Table 5b: Effect of GF-2726 on 21-Day Vegetative Vigor

Species	**Results summary for survival (lbs 2,4-D Choline Salt/A)**									
	%	NOEC	EC_{05}	95%CI	EC_{25}	95%CI	EC_{50}	95%CI	slope	95%CI
Horseweed	97-100	0.35	ND	N/A	>0.35	ND	>0.35	ND	N/A	N/A
Lambsquarter	100	0.71	ND	N/A	>0.71	ND	>0.71	ND	N/A	N/A
Quackgrass[1]	76-100	0.176	ND	N/A	>0.35	ND	>0.35	ND	N/A	N/A

ND- Not determined. NC- Not calculable.
[1] Significant decrease in quackgrass survival, inhibition of 24% at the 0.35 lb ai/A treatment level compared to the negative control (Cochran-Armitage test, $p<0.05$).

Plant Injury Index*				
Control	Horseweed	Lambsquarter	Quackgrass	Formulation Blank
0	0-70	0-70	0-60	N/A

*1-10 = no effect; 20-30 = slight effect; 40-60 = moderate effect; 70-100 = severe effect; 100 = complete effect.

C. VERIFICATION OF STATISTICAL RESULTS BY THE REVIEWER:

All analyses were conducted comparing treated to the negative control. These analyses were conducted using CETIS version 1.8.7.12 and backend settings approved for use by EFED on 10/20/2015. Data for each endpoint were tested to determine if their distributions were normal and if their variances were homogeneous using Shapiro-Wilk's and Levene's tests, respectively. Data that satisfied these assumptions were subjected to Dunnett's and William's tests, and data that did not satisfy these assumptions were subjected to the non-parametric Mann-Whitney U and Jonckheere's tests. Measured concentrations were used in analyses for the three highest treatment levels for each species, and nominal concentrations were used for the lower treatment levels. Linear (survival) and nonlinear (height and dry weight) regression models were used to interpret EC/ICx values.

Table 6: Effect of GF-2726 on 21-Day Vegetative Vigor

Species	Results summary for height (lbs 2,4-D Choline Salt/A)									
	height (mm)	NOEC	IC_{05}	95%CI	IC_{25}	95%CI	IC_{50}	95%CI	slope	95%CI
Horseweed[1]*	67-175	0.0110	0.000652	N/A-0.00563	0.0411	0.0186-0.0832	0.732*	0.197-2.72	N/A	N/A
Horseweed[2]	67-175	0.0110	0.00931	0.00539-0.013	0.0397	0.0333-0.0468	0.109	0.0974-0.122	N/A	N/A
Lambsquarter[3]	69.2-340	0.044	0.00632	N/A-0.0152	0.0352	0.0203-0.0556	0.116	0.0855-0.158	N/A	N/A
Quackgrass[4]*	311-437	0.083	0.0464	0.0128-0.082	0.282	0.209-0.369	0.987*	0.455-2.14	N/A	N/A

ND- Not determined. NC- Not calculable.

*Endpoints and/or confidence intervals are outside the tested range of concentrations and should be interpreted with caution.

[1] Significant decrease in horseweed height, inhibition of 9, 24, 44, 59, and 7% at the 0.0221, 0.044, 0.083, 0.179, and 0.35 lb ai/A treatment level, respectively, compared to the negative control (Williams test, $p<0.05$). The reviewer included data for the 0.35 lb ai/A treatment level for this row of results; the study author did not include the data in their analysis.

[2] The reviewer additionally ran horseweed data excluding the 0.35 lb ai/A treatment level, represented by this row of results.

[3] Significant decrease in lambsquarter height, inhibition of 65, 65, 68, and 77% at the 0.083, 0.179, 0.35 and 0.70 lb ai/A treatment level, respectively, compared to the negative control (Williams test, $p<0.05$).

[4] Significant decrease in quackgrass height, inhibition of 27 and 26% at the 0.179 and 0.35 lb ai/A treatment level, respectively, compared to the negative control (Dunnett's test, $p<0.05$).

Table 6a: Effect of GF-2726 on 21-Day Vegetative Vigor

Species	Results summary for biomass (lbs 2,4-D Choline Salt/A)									
	Weight (g)	NOEC	IC_{05}	95%CI	IC_{25}	95%CI	IC_{50}	95%CI	slope	95%CI
Horseweed[1]	0.0915-0.841	0.0110	0.000266	N/A-0.00624	0.0112	0.00261-0.0352	0.149	0.0572-0.39	N/A	N/A
Horseweed[2]	0.0915-0.841	0.0110	0.0106	0.00199-0.0151	0.0275	0.0179-0.0289	0.0532	0.0464-0.0609	N/A	N/A
Lambsquarter[3]	0.144-0.68	0.044	0.018	N/A 0.0485	0.0747	0.0282 0.144	0.201	0.128 0.316	N/A	N/A
Quackgrass[4]	0.15-0.645	0.083	0.0535	N/A-0.0836	0.113	0.0725-0.155	0.191	0.155-0.235	N/A	N/A

ND- Not determined. NC- Not calculable.

[1] Significant decrease in horseweed dry weight, inhibition of 19, 29, 71, 88, and 3% at the 0.0221, 0.044, 0.083, 0.179, and 0.35 lb ai/A treatment level, respectively, compared to the negative control (Williams test, $p<0.05$). The reviewer included data for the 0.35 lb ai/A treatment level; the study author did not include the data in their analysis.

[2] The reviewer additionally ran horseweed data excluding the 0.35 lb ai/A treatment level, represented by this row of results.

[3] Significant decrease in lambsquarter dry weight, inhibition of 47, 43, 60, and 71% at the 0.083, 0.179, 0.35 and 0.70 lb ai/A treatment level, respectively, compared to the negative control (Williams test, $p<0.05$).

[4] Significant decrease in quackgrass dry weight, inhibition of 52 and 70% at the 0.179 and 0.35 lb ai/A treatment level, respectively, compared to the negative control (Dunnett's test, $p<0.05$).

Table 6c: Effect of GF-2726 on 21-Day Vegetative Vigor

Species	Results summary for survival (lbs 2,4-D Choline Salt/A); based on # planted									
	%	NOEC	EC_{05}	95%CI	EC_{25}	95%CI	EC_{50}	95%CI	slope	95%CI
Horseweed	97-100	0.35	>0.35	N/A	>0.35	N/A	>0.35	N/A	N/A	N/A
Lambsquarter	100	0.70	>0.70	N/A	>0.70	N/A	>0.70	N/A	N/A	N/A
Quackgrass[1]	76-100	0.179	NC	N/A	>0.35	N/A	>0.35	N/A	N/A	N/A

ND- Not determined. NC- Not calculable.
[1] Significant decrease in quackgrass survival, inhibition of 24% at the 0.35 lb ai/A treatment level compared to the negative control (Mann-Whitney U Two-Sample test, $p<0.05$).

Plant Injury Index*				
Control	Horseweed	Lambsquarter	Quackgrass	Formulation Blank
0	0-70	0-70	0-60	N/A

*1-10 = no effect; 20-30 = slight effect; 40-60 = moderate effect; 70-100 = severe effect; 100 = complete effect.

2,4-D Choline Salt

Monocot

Most sensitive monocot: Quackgrass based on dry weight

EC_{50}/IC_{50}: 0.191 lb ai/A 95% C.I.: 0.155-0.235 lb ai/A
EC_{25}/IC_{25}: 0.113 lb ai/A 95% C.I.: 0.0725-0.155 lb ai/A
EC_{05}/IC_{05}: 0.0535 lb ai/A 95% C.I.: N/A-0.0836 lb ai/A
NOEC: 0.083 lb ai/A
Slope: N/A 95% C.I.: N/A

Dicot

Most sensitive dicot: Horseweed based on dry weight (with top dose included)

EC_{50}/IC_{50}: 0.149 lb ai/A 95% C.I.: 0.0572-0.39 lb ai/A
EC_{25}/IC_{25}: 0.0112 lb ai/A 95% C.I.: 0.00261-0.0352 lb ai/A
EC_{05}/IC_{05}: 0.000266 lb ai/A 95% C.I.: N/A-0.00624 lb ai/A
NOEC: 0.0110 lb ai/A
Slope: N/A 95% C.I.: N/A

Most sensitive dicot: Horseweed based on dry weight (with top dose excluded)

EC_{50}/IC_{50}: 0.0532 lb ai/A	95% C.I.: 0.0464-0.0609 lb ai/A
EC_{25}/IC_{25}: 0.0275 lb ai/A	95% C.I.: 0.0218-0.0335 lb ai/A
EC_{05}/IC_{05}: 0.0106 lb ai/A	95% C.I.: 0.00199-0.0151 lb ai/A
NOEC: 0.0110 lb ai/A	
Slope: N/A	95% C.I.: N/A

Glyphosate DMA

Monocot

Most sensitive monocot: Quackgrass based on dry weight

EC_{50}/IC_{50}: 0.172 lb ai/A	95% C.I.: 0.140-0.212 lb ai/A
EC_{25}/IC_{25}: 0.102 lb ai/A	95% C.I.: 0.065-0.140 lb ai/A
EC_{05}/IC_{05}: 0.048 lb ai/A	95% C.I.: N/A-0.075 lb ai/A
NOEC: 0.075 lb ai/A	
Slope: N/A	95% C.I.: N/A

Dicot

Most sensitive dicot: Horseweed based on dry weight (with top dose included)

EC_{50}/IC_{50}: 0.134 lb ai/A	95% C.I.: 0.052-0.351 lb ai/A
EC_{25}/IC_{25}: 0.010 lb ai/A	95% C.I.: 0.0024-0.0317 lb ai/A
EC_{05}/IC_{05}: 0.00024 lb ai/A	95% C.I.: N/A-0.0056 lb ai/A
NOEC: 0.0099 lb ai/A	
Slope: N/A	95% C.I.: N/A

Most sensitive dicot: Horseweed based on dry weight (with top dose excluded)

EC_{50}/IC_{50}: 0.048 lb ai/A	95% C.I.: 0.042-0.055 lb ai/A
EC_{25}/IC_{25}: 0.0248 lb ai/A	95% C.I.: 0.0196-0.0302 lb ai/A
EC_{05}/IC_{05}: 0.00954 lb ai/A	95% C.I.: 0.0018-0.0136 lb ai/A
NOEC: 0.0099 lb ai/A	
Slope: N/A	95% C.I.: N/A

D. STUDY DEFICIENCIES:

1. The quackgrass study included 25 seedlings per treatment, and EPA recommends a minimum of 30 seedlings per treatment. The study author indicated they communicated with EPA, and EPA approved 25 seedlings per treatment.

2. The study author reported that for horseweed, there was a clear monotonic treatment-dependent effect on mean shoot weight between 0.0221 and 0.176 lb 2,4 D Choline Salt/A, but this was not evident at the highest treatment level (0.35 lb 2,4 D Choline Salt/A). The reason for the inconsistent response at the highest treatment rate is uncertain, but is unlikely to be due to incorrect treatment preparation given that the other species did not show a similar response. However, due to this inconsistency, the study author excluded the highest treatment level from the statistical analysis to provide a conservative assessment of the effect on shoot weight for horseweed. The reviewer conducted statistical analysis both including and excluding the top dose.

3. The physico-chemical properties of the test material were not reported.

E. REVIEWER'S COMMENTS:

The reviewer and study author agreed on the most sensitive endpoints. Based on the study author's results, the most sensitive monocot was quackgrass based on dry weight, with NOEC and ER_{25} values of 0.088 and 0.116 lb 2,4-D Choline Salt/A, respectively; the most sensitive dicot was horseweed based on dry weight, with a NOEC and ER_{25} value of 0.0110 and 0.0287 lb 2,4-D Choline Salt/A, respectively. For horseweed growth, the top dose did not conform to the overall strongly dose-dependent pattern. The study author could not explain this aberration and excluded the top dose from analysis. The reviewer conducted analyses including and excluding the top dose. The reviewer determined the most sensitive dicot to be horseweed based on dry weight with NOAEC and IC_{25} values of 0.0110 and 0.0112 lb 2,4-D Choline Salt/A (including the top dose) and 0.0275 lb 2,4-D Choline Salt/A (excluding the top dose), respectively. The reviewer determined that the most sensitive monocot was quackgrass based on dry weight with NOAEC and IC_{25} values of 0.083 and 0.113 lb 2,4-D Choline Salt/A, respectively.

The in-life portion of this study was March 1, 2016 to March 22, 2016.

F. CONCLUSIONS:

This study is scientifically sound and is classified as acceptable The most sensitive monocot was quackgrass based on dry weight with NOAEC and IC_{25} values of 0.083 and 0.113 lb 2,4-D Choline Salt/A, respectively. The most sensitive dicot was horseweed based on dry weight with NOAEC and IC_{25} values of 0.0110 and 0.0112 lb 2,4-D Choline Salt/A (including the top dose) and 0.0275 lb 2,4-D Choline Salt/A (excluding the top dose), respectively.

Most sensitive monocot and IC_{25}: Quackgrass (dry weight, 0.113 lb 2,4-D Choline Salt/A)
Most sensitive dicot and IC_{25}: Horseweed (dry weight incl. top dose, 0.0112 lb 2,4-D Choline Salt/A)
Most sensitive dicot and IC_{25}: Horseweed (dry weight excl. top dose, 0.0275 lb 2,4-D Choline Salt/A)

Most sensitive monocot and IC_{25}: Quackgrass (dry weight, 0.102 lb Glyphosate DMA/A)
Most sensitive dicot and IC_{25}: Horseweed (dry weight incl. top dose, 0.0101 lb Glyphosate DMA/A)
Most sensitive dicot and IC_{25}: Horseweed (dry weight excl. top dose, 0.0248 lb Glyphosate DMA/A)

Most sensitive monocot and IC_{25}: Quackgrass (dry weight, 0.469 lb Total Product/A)
Most sensitive dicot and IC_{25}: Horseweed (dry weight incl. top dose, 0.0465 lb Total Product/A)
Most sensitive dicot and IC_{25}: Horseweed (dry weight excl. top dose, 0.1141 lb Total Product/A)

III. REFERENCES:

1. U.S. Environmental Protection Agency - 1982. Pesticide Assessment Guidelines. Subdivision J. Hazard Evaluation: Non-Target Plants; Series 123-1 Seed germination/vegetative vigor and vegetative vigor (Tier 2).

2. U.S. Environmental Protection Agency, Series 850- Ecological Effects Test Guidelines, OCSPP Number 850.4100: Vegetative vigor and Seedling Growth. 2012.

3. Frans, R.E. and Talbert, R.E., Design of Field Experiments and the Measurement and Analysis of Plant Responses. Pages 15-23 in B. Truelove, ed. Research Methods in Weed Science. Southern Weed Science Society, Auburn University, Alabama, 1977.

4. Bergfield, A. 2016. "GF-2726 (2,4-D Choline Salt, 286 g a.s./L; Glyphosate Dimethylammonium 260 g a.s./L SL): Effects on the Seedling Emergence and Growth of Non-Target Terrestrial Plants (Tier II)" ABC Laboratories, Inc. Study No. 83625, Dow AgroSciences Study No. 160304.

OCSPP 850.4150 Terrestrial Plant Tier II (Vegetative Vigor) **ABC Labs**

Batch ID:	18-1296-3197	**Test Type:**	Vegetative Vigor Tier II	**Analyst:**	
Start Date:	01 Mar-16	**Protocol:**	OCSPP 850.4150 Plant Vegetative Vigor	**Diluent:**	
Ending Date:	15 Jun-16 18:32	**Species:**	Conyza canadensis	**Brine:**	
Duration:	106d 19h	**Source:**	Dow AgroSciences	**Age:**	
Sample ID:	15-4646-6094	**Code:**	49903204 horsew	**Client:**	CDM Smith - T. Nelis
Sample Date:	01 Mar-16	**Material:**	2,4-D choline salt	**Project:**	
Receive Date:	15 Jun-16 18:32	**Source:**	Dow AgroSciences		
Sample Age:	NA	**Station:**			

Batch Note: 2,4-D Choline Salt + Glyphosate DMA

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
15-5314-8300	Height	0.0221	0.044	0.03118	11.5%		Dunnett Multiple Comparison Test
05-4500-4357	Height	0.011	0.0221	0.01559	8.38%		Williams Multiple Comparison Test
00-5190-7660	Survival	0.35	>0.35	NA	2.25%		Mann-Whitney U Two-Sample Test
05-1986-2115	Weight	0.0221	0.044	0.03118	19.4%		Dunnett Multiple Comparison Test
15-2011-4579	Weight	0.011	0.0221	0.01559	14.1%		Williams Multiple Comparison Test

Point Estimate Summary

Analysis ID	Endpoint	Level	lbs ai/A	95% LCL	95% UCL	TU	Method
06-4415-0940	Height	IC5	0.000652	N/A	0.00563		Nonlinear Regression
		IC10	0.00308	0.000287	0.0118		
		IC25	0.0411	0.0186	0.0832		
		IC50	0.732	0.197	2.72		
18-6891-0688	Weight	IC5	0.000266	N/A	0.00624		Nonlinear Regression
		IC10	0.00108	N/A	0.00823		
		IC25	0.0112	0.00261	0.0352		
		IC50	0.149	0.0572	0.39		

OCSPP 850.4150 Terrestrial Plant Tier II (Vegetative Vigor) **ABC Labs**

Height Summary

C-lbs ai/A	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	6	165	148	181	140	182	6.39	15.7	9.5%	0.0%
0.00138		6	175	164	185	163	190	3.97	9.73	5.57%	-5.97%
0.0027		6	167	144	190	142	197	8.94	21.9	13.1%	-1.42%
0.0055		6	175	163	187	156	188	4.8	11.8	6.72%	-6.17%
0.011		6	166	152	179	153	190	5.28	12.9	7.8%	-0.51%
0.0221		6	149	137	162	133	165	4.84	11.8	7.93%	9.4%
0.044		6	126	113	139	111	146	5.13	12.6	9.99%	23.7%
0.083		6	91.7	79	104	72	104	4.92	12	13.1%	44.4%
0.179		6	67	60.2	73.8	58	74	2.63	6.45	9.63%	59.4%
0.35		6	153	140	165	136	166	4.91	12	7.88%	7.38%

Survival Summary

C-lbs ai/A	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	6	1	1	1	1	1	0	0	0.0%	0.0%
0.00138		6	1	1	1	1	1	0	0	0.0%	0.0%
0.0027		6	1	1	1	1	1	0	0	0.0%	0.0%
0.0055		6	1	1	1	1	1	0	0	0.0%	0.0%
0.011		6	1	1	1	1	1	0	0	0.0%	0.0%
0.0221		6	1	1	1	1	1	0	0	0.0%	0.0%
0.044		6	1	1	1	1	1	0	0	0.0%	0.0%
0.083		6	1	1	1	1	1	0	0	0.0%	0.0%
0.179		6	0.972	0.901	1	0.833	1	0.0278	0.068	7.0%	2.78%
0.35		6	1	1	1	1	1	0	0	0.0%	0.0%

Weight Summary

C-lbs ai/A	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	6	0.745	0.658	0.832	0.638	0.844	0.0338	0.0828	11.1%	0.0%
0.00138		6	0.841	0.752	0.93	0.738	0.933	0.0345	0.0845	10.0%	-12.9%
0.0027		6	0.812	0.686	0.939	0.61	0.93	0.0493	0.121	14.9%	-9.08%
0.0055		6	0.775	0.69	0.86	0.712	0.92	0.0329	0.0807	10.4%	-4.07%
0.011		6	0.725	0.596	0.853	0.585	0.866	0.0498	0.122	16.8%	2.72%
0.0221		6	0.607	0.513	0.701	0.513	0.751	0.0364	0.0892	14.7%	18.5%
0.044		6	0.526	0.384	0.669	0.405	0.723	0.0554	0.136	25.8%	29.3%
0.083		6	0.215	0.122	0.309	0.116	0.345	0.0364	0.0891	41.4%	71.1%
0.179		6	0.0915	0.0662	0.117	0.065	0.131	0.00985	0.0241	26.4%	87.7%
0.35		6	0.724	0.592	0.857	0.542	0.86	0.0516	0.126	17.4%	2.75%

OCSPP 850.4150 Terrestrial Plant Tier II (Vegetative Vigor) **ABC Labs**

Height Detail

C-lbs ai/A	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6
0	Negative Control	159	169	140	182	159	180
0.00138		171	173	163	169	190	182
0.0027		170	143	142	167	184	197
0.0055		188	169	181	156	172	184
0.011		157	165	166	163	153	190
0.0221		159	133	142	144	153	165
0.044		121	146	130	131	116	111
0.083		93	104	98	83	72	100
0.179		58	72	66	71	61	74
0.35		136	150	163	159	166	142

Survival Detail

C-lbs ai/A	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6
0	Negative Control	1	1	1	1	1	1
0.00138		1	1	1	1	1	1
0.0027		1	1	1	1	1	1
0.0055		1	1	1	1	1	1
0.011		1	1	1	1	1	1
0.0221		1	1	1	1	1	1
0.044		1	1	1	1	1	1
0.083		1	1	1	1	1	1
0.179		1	1	1	1	1	0.833
0.35		1	1	1	1	1	1

Weight Detail

C-lbs ai/A	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6
0	Negative Control	0.638	0.844	0.677	0.757	0.72	0.833
0.00138		0.897	0.759	0.933	0.738	0.915	0.803
0.0027		0.89	0.61	0.776	0.764	0.905	0.93
0.0055		0.82	0.738	0.718	0.743	0.712	0.92
0.011		0.585	0.639	0.791	0.866	0.625	0.84
0.0221		0.653	0.513	0.52	0.751	0.617	0.588
0.044		0.723	0.464	0.405	0.672	0.47	0.424
0.083		0.248	0.345	0.275	0.133	0.116	0.176
0.179		0.065	0.0869	0.131	0.107	0.0736	0.0854
0.35		0.686	0.627	0.829	0.803	0.86	0.542

OCSPP 850.4150 Terrestrial Plant Tier II (Vegetative Vigor) **ABC Labs**

Batch ID:	01-5930-3610	**Test Type:**	Vegetative Vigor Tier II	**Analyst:**	
Start Date:	01 Mar-16	**Protocol:**	OCSPP 850.4150 Plant Vegetative Vigor	**Diluent:**	
Ending Date:	15 Jun-16 18:48	**Species:**	Chenopodium album	**Brine:**	
Duration:	106d 19h	**Source:**	Dow AgroSciences	**Age:**	
Sample ID:	02-4480-1631	**Code:**	49903204 lambsq	**Client:**	CDM Smith - T. Nelis
Sample Date:	01 Mar-16	**Material:**	2,4-D choline salt	**Project:**	
Receive Date:	15 Jun-16 18:48	**Source:**	Dow AgroSciences		
Sample Age:	NA	**Station:**			

Batch Note: 2,4-D Cholin eSalt + Glyphosate DMA

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
14-3769-0411	Height	0.044	0.083	0.06043	27.6%		Dunnett Multiple Comparison Test
06-6074-9073	Height	0.044	0.083	0.06043	19.8%		Williams Multiple Comparison Test
21-3404-5506	Survival	0.7	>0.7	NA	NA		Mann-Whitney U Two-Sample Test
14-5891-4841	Weight	0.35	0.7	0.495	60.4%		Dunnett Multiple Comparison Test
14-5830-0916	Weight	0.044	0.083	0.06043	43.4%		Williams Multiple Comparison Test

Point Estimate Summary

Analysis ID	Endpoint	Level	lbs ai/A	95% LCL	95% UCL	TU	Method
04-9917-8238	Height	IC5	0.00632	N/A	0.0152		Nonlinear Regression
		IC10	0.012	0.00355	0.0223		
		IC25	0.0352	0.0203	0.0556		
		IC50	0.116	0.0855	0.158		
14-1882-5301	Weight	IC5	0.018	N/A	0.0485		Nonlinear Regression
		IC10	0.0306	N/A	0.0692		
		IC25	0.0747	0.0282	0.144		
		IC50	0.201	0.128	0.316		

OCSPP 850.4150 Terrestrial Plant Tier II (Vegetative Vigor) **ABC Labs**

Height Summary

C-lbs ai/A	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	6	303	248	357	246	376	21.3	52.2	17.3%	0.0%
0.00138		6	302	222	382	219	439	31.2	76.4	25.3%	0.28%
0.0027		6	322	223	421	179	421	38.5	94.4	29.3%	-6.56%
0.0055		6	327	253	400	237	407	28.6	70.1	21.4%	-7.99%
0.011		6	324	248	399	244	400	29.4	72	22.2%	-7.0%
0.0221		6	340	288	392	267	402	20.3	49.8	14.6%	-12.4%
0.044		6	283	249	316	244	321	13	31.9	11.3%	6.5%
0.083		6	106	69.7	142	65	164	14	34.3	32.5%	65.1%
0.179		6	105	56.5	154	65	180	18.9	46.4	44.1%	65.2%
0.35		6	96.2	61.5	131	59	141	13.5	33.1	34.4%	68.2%
0.7		6	69.2	35.9	102	30	109	12.9	31.7	45.8%	77.1%

Survival Summary

C-lbs ai/A	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	6	1	1	1	1	1	0	0	0.0%	0.0%
0.00138		6	1	1	1	1	1	0	0	0.0%	0.0%
0.0027		6	1	1	1	1	1	0	0	0.0%	0.0%
0.0055		6	1	1	1	1	1	0	0	0.0%	0.0%
0.011		6	1	1	1	1	1	0	0	0.0%	0.0%
0.0221		6	1	1	1	1	1	0	0	0.0%	0.0%
0.044		6	1	1	1	1	1	0	0	0.0%	0.0%
0.083		6	1	1	1	1	1	0	0	0.0%	0.0%
0.179		6	1	1	1	1	1	0	0	0.0%	0.0%
0.35		6	1	1	1	1	1	0	0	0.0%	0.0%
0.7		6	1	1	1	1	1	0	0	0.0%	0.0%

Weight Summary

C-lbs ai/A	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	6	0.503	0.337	0.669	0.357	0.764	0.0647	0.159	31.5%	0.0%
0.00138		6	0.501	0.283	0.718	0.273	0.896	0.0847	0.207	41.4%	0.45%
0.0027		6	0.59	0.269	0.911	0.25	0.972	0.125	0.306	51.8%	-17.4%
0.0055		6	0.59	0.31	0.871	0.314	0.955	0.109	0.267	45.3%	-17.3%
0.011		6	0.638	0.316	0.959	0.339	1.13	0.125	0.306	48.0%	-26.8%
0.0221		6	0.68	0.449	0.911	0.382	0.988	0.0898	0.22	32.3%	-35.2%
0.044		6	0.652	0.446	0.859	0.385	0.893	0.0803	0.197	30.2%	-29.6%
0.083		6	0.268	0.124	0.412	0.147	0.529	0.0561	0.137	51.3%	46.7%
0.179		6	0.286	0.0887	0.484	0.124	0.534	0.0769	0.188	65.8%	43.1%
0.35		6	0.202	0.11	0.294	0.0997	0.321	0.0357	0.0875	43.3%	59.8%
0.7		6	0.144	0.0626	0.226	0.0336	0.251	0.0317	0.0778	53.9%	71.3%

OCSPP 850.4150 Terrestrial Plant Tier II (Vegetative Vigor) **ABC Labs**

Height Detail

C-lbs ai/A	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6
0	Negative Control	376	267	326	340	260	246
0.00138		439	328	256	289	279	219
0.0027		421	386	398	275	275	179
0.0055		405	407	339	301	271	237
0.011		400	371	389	294	244	244
0.0221		402	360	294	356	361	267
0.044		321	304	244	305	273	250
0.083		164	112	117	65	92	84
0.179		180	141	101	77	67	65
0.35		141	128	102	72	75	59
0.7		109	97	69	74	36	30

Survival Detail

C-lbs ai/A	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6
0	Negative Control	1	1	1	1	1	1
0.00138		1	1	1	1	1	1
0.0027		1	1	1	1	1	1
0.0055		1	1	1	1	1	1
0.011		1	1	1	1	1	1
0.0221		1	1	1	1	1	1
0.044		1	1	1	1	1	1
0.083		1	1	1	1	1	1
0.179		1	1	1	1	1	1
0.35		1	1	1	1	1	1
0.7		1	1	1	1	1	1

Weight Detail

C-lbs ai/A	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6
0	Negative Control	0.764	0.406	0.561	0.568	0.357	0.363
0.00138		0.896	0.459	0.451	0.455	0.471	0.273
0.0027		0.972	0.866	0.731	0.419	0.305	0.25
0.0055		0.87	0.955	0.589	0.442	0.371	0.314
0.011		1.13	0.774	0.757	0.439	0.385	0.339
0.0221		0.988	0.873	0.598	0.56	0.681	0.382
0.044		0.893	0.868	0.534	0.385	0.59	0.643
0.083		0.529	0.234	0.282	0.147	0.248	0.168
0.179		0.534	0.512	0.25	0.141	0.157	0.124
0.35		0.321	0.251	0.243	0.192	0.105	0.0997
0.7		0.251	0.153	0.145	0.199	0.0843	0.0336

OCSPP 850.4150 Terrestrial Plant Tier II (Vegetative Vigor) **ABC Labs**

Batch ID:	15-0648-6495	**Test Type:**	Vegetative Vigor Tier II	**Analyst:**	
Start Date:	01 Mar-16	**Protocol:**	OCSPP 850.4150 Plant Vegetative Vigor	**Diluent:**	
Ending Date:		**Species:**	Agropyron repens	**Brine:**	
Duration:	NA	**Source:**	Dow AgroSciences	**Age:**	
Sample ID:	10-3531-1811	**Code:**	49903204 quackg	**Client:**	CDM Smith - T. Nelis
Sample Date:	01 Mar-16	**Material:**	2,4-D choline salt	**Project:**	
Receive Date:		**Source:**	Dow AgroSciences		
Sample Age:	NA	**Station:**			

Batch Note: 2,4-D Choline Salt + Glyphosate DMA

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
09-6854-2043	Height	0.083	0.179	0.1219	11.8%		Dunnett Multiple Comparison Test
04-7316-8298	Height	0.083	0.179	0.1219	8.68%		Williams Multiple Comparison Test
04-5141-4108	Survival	0.179	0.35	0.2503	8.59%		Mann-Whitney U Two-Sample Test
09-0106-5112	Weight	0.083	0.179	0.1219	38.8%		Dunnett Multiple Comparison Test

Point Estimate Summary

Analysis ID	Endpoint	Level	lbs ai/A	95% LCL	95% UCL	TU	Method
12-0682-8496	Height	IC5	0.0464	0.0128	0.082		Nonlinear Regression
		IC10	0.0912	0.0496	0.139		
		IC25	0.282	0.209	0.369		
		IC50	0.987	0.455	2.14		
17-6948-7545	Weight	IC5	0.0535	N/A	0.0836		Nonlinear Regression
		IC10	0.0709	N/A	0.105		
		IC25	0.113	0.0725	0.155		
		IC50	0.191	0.155	0.235		

OCSPP 850.4150 Terrestrial Plant Tier II (Vegetative Vigor) **ABC Labs**

Height Summary

C-lbs ai/A	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	5	426	406	446	410	451	7.28	16.3	3.82%	0.0%
0.0027		5	413	355	472	372	478	21	47	11.4%	3.0%
0.0055		5	437	400	475	389	460	13.5	30.2	6.9%	-2.68%
0.011		5	410	392	429	389	428	6.75	15.1	3.68%	3.66%
0.0221		5	409	372	445	374	455	13.1	29.3	7.16%	4.04%
0.044		5	415	378	452	366	446	13.3	29.8	7.17%	2.54%
0.083		5	414	379	449	375	449	12.5	28	6.76%	2.86%
0.179		5	311	253	369	239	360	20.9	46.7	15.0%	27.0%
0.35		5	315	277	354	272	352	13.9	31.1	9.86%	26.0%

Survival Summary

C-lbs ai/A	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	5	1	1	1	1	1	0	0	0.0%	0.0%
0.0027		5	1	1	1	1	1	0	0	0.0%	0.0%
0.0055		5	1	1	1	1	1	0	0	0.0%	0.0%
0.011		5	1	1	1	1	1	0	0	0.0%	0.0%
0.0221		5	1	1	1	1	1	0	0	0.0%	0.0%
0.044		5	1	1	1	1	1	0	0	0.0%	0.0%
0.083		5	1	1	1	1	1	0	0	0.0%	0.0%
0.179		5	1	1	1	1	1	0	0	0.0%	0.0%
0.35		5	0.76	0.488	1	0.4	1	0.098	0.219	28.8%	24.0%

Weight Summary

C-lbs ai/A	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	5	0.501	0.389	0.614	0.354	0.594	0.0404	0.0904	18.0%	0.0%
0.0027		5	0.566	0.399	0.734	0.453	0.762	0.0603	0.135	23.8%	-12.9%
0.0055		5	0.645	0.432	0.858	0.393	0.864	0.0769	0.172	26.6%	-28.6%
0.011		5	0.61	0.473	0.748	0.44	0.746	0.0496	0.111	18.2%	-21.7%
0.0221		5	0.566	0.373	0.759	0.356	0.783	0.0695	0.155	27.5%	-12.9%
0.044		5	0.588	0.417	0.76	0.357	0.698	0.0618	0.138	23.5%	-17.3%
0.083		5	0.603	0.451	0.756	0.473	0.757	0.0548	0.123	20.3%	-20.3%
0.179		5	0.239	0.115	0.362	0.139	0.353	0.0444	0.0994	41.6%	52.4%
0.35		5	0.15	0.0904	0.21	0.118	0.234	0.0215	0.048	32.0%	70.1%

OCSPP 850.4150 Terrestrial Plant Tier II (Vegetative Vigor) **ABC Labs**

Height Detail

C-lbs ai/A	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
0	Negative Control	413	410	451	429	427
0.0027		386	382	372	448	478
0.0055		459	460	452	389	427
0.011		409	428	405	389	421
0.0221		455	407	374	408	400
0.044		415	366	446	423	426
0.083		403	430	449	375	412
0.179		239	360	315	299	342
0.35		302	314	272	337	352

Survival Detail

C-lbs ai/A	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
0	Negative Control	1	1	1	1	1
0.0027		1	1	1	1	1
0.0055		1	1	1	1	1
0.011		1	1	1	1	1
0.0221		1	1	1	1	1
0.044		1	1	1	1	1
0.083		1	1	1	1	1
0.179		1	1	1	1	1
0.35		0.8	0.8	0.8	1	0.4

Weight Detail

C-lbs ai/A	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
0	Negative Control	0.354	0.492	0.535	0.594	0.533
0.0027		0.493	0.651	0.453	0.471	0.762
0.0055		0.665	0.708	0.595	0.393	0.864
0.011		0.746	0.648	0.595	0.621	0.44
0.0221		0.577	0.356	0.507	0.783	0.607
0.044		0.357	0.681	0.572	0.634	0.698
0.083		0.49	0.685	0.757	0.611	0.473
0.179		0.139	0.353	0.236	0.142	0.324
0.35		0.122	0.118	0.134	0.142	0.234